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able to bring about; it is this elimination, and nothing else, that constitutes the curative action.

I will now beg the reader to ponder over the two following facts, and see if he can reconcile them with Dr. Takaki's theory: 1st. The mountaineers of Japan, who have the reputation of being rice gluttons, eating, in fact, nothing else, are never afflicted with beri-beri. 2nd. There is, in the mountains of Japan, one beri-beri centre, and only one. What is more, this exceptional place is 800 metres above sea-level, it is called Shinano.[3] But see how strikingly, here, the exception confirms the rule. Shinano is again surrounded by higher hills, so that it is really a cup from which the carbonic gases cannot escape. The outbreaks of beri-beri in Shinano are explained by the latter circumstance, not by any extra rice-gluttony of the Shinanoans, or the excessive humidity of their climate.

THE ORIGIN OF GOLD.

BY PHILIP LAKE, CAMBRIDGE, ENGLAND.

THE subject of the origin of gold, or of the manner in which that metal has reached its present positions, is one which has at all times excited considerable attention, and the number of theories put forward has been almost as great as the number of writers on the question.

It is easy to understand the presence of gold in alluvial deposits, for this has clearly been derived from pre-existing rocks; but the difficulty lies in determining how the auriferous quartz-reefs and other rocks which we look upon as the home of the gold, became impregnated.

Sir Roderick Murchison, from his observations in the Ural Mountains, originally held that non-alluvial gold was only found in Paleozoic rocks, and principally in his Lower Silurian; but he believed that it was not introduced into these rocks until shortly before the Drift period. Subsequently he was led to modify these views to a certain extent, and to admit that Secondary and Tertiary strata when penetrated by igneous rocks or impregnated by mineral veins, might also contain gold.

More recent observations show that gold may be found in rocks of any age in metamorphic strata; but all the evidence seems to support Murchison's next contention, viz., that gold is of igneous origin.

There is probably no more instructive area to illustrate this than Southern India, where the distribution of gold has been carefully worked out by Mr. R. B. Foote, of the Geological Survey of India. Almost the whole of this part of India is made of crystalline and metamorphic rocks; and in it there are a large number of gold fields, more or less rich. A closer examination of the country shows that we have here a large mass of gneissic and granitoid rock which is crossed by a number of bands of schist, lava flows, hæmatite beds and conglomerates. Mr. Foote has shown that these bands belong to a system which is distinct from, and newer than, the gneiss, and to this system he has given the name of Dharwar. He has shown also that all the gold fields of Southern India, with the possible exception of the Wynaad, lie within these Dharwar bands.

As usual, the gold is found principally in quartz-reefs; and it is a remarkable fact that though quartz-reefs are by no means uncommon in the gneiss, as well as in the Dharwar beds, yet those in the gneiss are never auriferous. It is clear therefore that the gold cannot have been introduced into the reefs from below, for in that case there would be no difference in that respect between the reefs in the gneiss and the reefs in the Dharwar.

Only one other possible conclusion remains, viz., that the gold originally lay in the Dharwar rocks themselves, and that it has since, by some process of segregation, been gathered together in the quartz-reefs.

It has already been stated that lava-flows occur among the Dharwar rocks; and my own observations have led me to believe that many of the schists also are lava-flows. In fact a very large part, if not the greater part, of the system appears to be of volcanic origin.

It may be concluded therefore that the gold which we now find in the auriferous reefs of Southern India was derived from the rocks of the Dharwar system; and that it was originally brought up from the depths of the earth by the lava-flows which form so large a part of that system.

ON THE EXTREMES OF HEAT AND COLD UNDER WHICH THE LIFE OF SPECIES IS POSSIBLE.

BY HENRY DE VARIGNY, SC. D., MUSUEM OF NATURAL HISTORY, PARIS, FRANCE.

MARQUIS DE NADAILLAC contributed some months ago (January 27, 1893, page 49) to this paper an interesting note concerning the extremes of heat and cold endured by man, on the extremes of external temperature which man has been able to resist. The topic I wish to call attention to is entirely different. We all know that man, for instance, when resisting the extremes of heat and cold, hardly alters at all his internal temperature, and that when for some reason or other the latter decreases or increases, life is in great peril. To show the extremes of heat and cold man can endure is merely to illustrate the means he has at his disposal to fight heat and cold and to maintain his own internal temperature, and as these means are numerous and powerful, we may well feel assured that man may resist very extreme conditions by intelligent use of the offensive or defensive weapons he is provided with. The matter I wish to call attention to is the very reverse, in one sense, of the facts quoted by Marquis de Nadaillac. I wish to show which are the extremes of heat or cold which individuals may really undergo permanently, without damage to themselves and posterity. To answer the question, we need to consider organisms which have no proper heat to speak of, but assume the temperature of their environment; we want what generally goes by the name of *cold-blooded*, or *heterothermal* organisms, and we must have them aquatic, not terrestrial, because we very well know that terrestrial cold-blooded animals do not necessarily have the same temperature as the air which surrounds them; nor do plants. Air is a bad conductor of heat, and in air evaporation and transpiration prevent the temperature from going very high. So we want organisms living in water, because in this case, as they hardly produce any heat, they must necessarily have the temperature of the water they live in, moreover we want our organisms to be able to withstand heat or cold, not only individually, but specifically: they must resist as individuals and as members of a species, they must be able to proceed to reproduction. In fact, what we want is the permanent extreme degree of water (in heat and cold) under which organisms are able to live, and to give off posterity.

As far as I can judge at present, these extreme degrees are, in Centigrade scale, minus 2° and plus 74°.

Arctic explorations have shown that even within the

[3] "Even the rule that the disease does not overstep certain quite low levels is shaken now; for the province of Shinano, walled in by mighty mountain chains, forms a plateau which, in many Kakke-ridden places, is raised 800 metres above the level of the sea. But, although these regions are not near the sea-level, they have yet a comparative depression; that is, they are low-lying plains, by the side of the circumjacent mountains, a circumstance of vast significance." BAELZ.

"Within the cities, also, the deep-lying parts show more cases of the disease than those of an elevated situation." BAELZ.

coldest of northern regions life is never totally absent, and may be found when carefully searched for. But, it must be conceded, life becomes "living," so to say, only during a very short period, a rapid summer, during which the temperature rises above zero. The study of marine cold-blooded organisms, in the northern climes, furnishes, I think, the extreme limit of cold under which organisms can live and reproduce themselves. Fr. Kjellmann, during his wintering in Mosselbay (Spitzbergen) some twenty years ago, observed a number of algæ at the coldest period of the year, and was satisfied, by direct observation, that they did most decidedly give issue to the sexual elements, and that the process of reproduction was in full activity while the temperature of the water was permanently below zero, between –1° and –3° (salt water having a lower freezing point than fresh, about 3°). I do not know of instances of organisms thriving individually and specifically at lower temperatures, of organisms doing the same, while their internal temperature cannot be above that of the environment. Lichens must certainly be considered as living at much lower temperatures, since they perform the breathing function at –10°, –20° and at much lower aerial temperatures, but do they reproduce themselves under such conditions? Experiments are wanting, and till they have been performed, we may consider that the *lowest internal temparatures* at which organisms may *thrive and reproduce*, is –2° or –3°, and that some algæ do live under these conditions in the northern seas amidst the blocks of ice (Kjellmann: *Vegetation hivernale du Algues a Mosselbay, Spitzberg, apres les observations faites pendant l'expedition polaire suedoise en* 1872-1873: *Comptes Rendus de l'Academie des Sciences*, 1875).

As to extreme heat, I find no instance more satisfactory than that of Van Tieghem. In a paper, *Sur des bacterianes vivant a la temperature de 74° Centigrades* (published in the *Bulletin de la Societe Botanique de France*, 1881, Vol. 28), he has given the results of his experiments on certain bacteria, and has found that one species is able to thrive and to reproduce itself at 74°, while at 77° it dies. Many other micro-organisms can bear for some time 60° or 70° C., but I know of no other able to live permanently at 74° and to give posterity under such conditions. No doubt a large number of observers, of whom I have given some names, with the results they have obtained, in a paper: *Les temperatures extremes compatibles avec la vie*, (*Revue Scientifique*, 27 May, 1893), have given instances of plants and animals living in hot springs, and, if some were to be believed, animals and plants would have been found in boiling water. I do not say the thing is impossible, but great care must be taken when ascertaining the temperature of thermal waters. Hoffe Seyler has shown that under the uppermost layer of water, which may be very warm, colder layers are to be found, and animals may seem to live in heated water, when in fact they live in normal conditions. Unless special care is taken to observe the temperature at the very level where living organisms are found, we can take no serious account of the numerous and startling observations made by a number of travellers, and abstracted by Goeffert, formerly, and recently by H. Weed (*9th Ann. Rep. of U. S. Geol. Survey by Powell*, p. 619). There is no reason to suppose that no organisms can live and reproduce themselves at an internal temperature of more than 74°. Such organisms do doubtless exist, but we cannot feel assured of the fact yet. Persons who investigate thermal springs should be very careful in their measurements; correct observations can be of great use for the present question, although, in point of fact, I much prefer a good experiment, such as that of Van Tieghem's. But nothing prevents the completion of the observation by experiment.

BOOK-REVIEWS.

Abnormal Man: Being Essays on Education and Crime and Related Subjects. By ARTHUR MACDONALD. Washington: Government.

THIS is a goodly pamphlet of more than four hundred pages issued by the Bureau of Education, of which the author is an officer. It is of a somewhat desultory character, consisting mainly, as the author says in his preface, "of essays and of digests of foreign literature which have already appeared in different periodicals." These various articles, however, have been changed, more or less, and much new matter has been added. The object of the book is to inquire into the causes of crime with a view to their removal, and especially to consider the influence of education in repressing crime. It opens with a brief notice of the various classes of abnormal men, whom the author divides into four classes: the dependent class, including the inmates of almshouses, hospitals, orphan asylums, etc.; the delinquent class, or criminals; the defective class, such as the insane, imbecile, deaf and dumb and others; and finally, men of genius or great talent. The ranking of men of genius with the other classes mentioned is itself a rather abnormal proceeding, and the chapter in which the author endeavors to show that genius is nearly allied to insanity is likely to meet with little favor. His remarks on that subject, however, are aside from the main purpose of the book, which is to treat of the criminal class and the methods of eliminating or repressing it.

At the outset Mr. MacDonald raises the question whether and in what way the elementary education that has now become so general throughout the civilized world affects the increase or decrease of crime; and after presenting many tables of statistics on the subject, comes to the conclusion, which the reader is likely to share, that "the exact relation between education and crime is unknown." He remarks, however, that "it would be difficult to find a criminal who in a single instance could attribute the cause of his crime to education;" and adds that "perhaps as good a test as any is for one to ask himself if the teaching of ordinary branches in his school days gave rise to immoral or criminal desires." But if school education does not increase crime, there is not much evidence that it tends to diminish crime; and thus we are brought to the subject of moral education as distinguished from the intellectual sort, which is the chief product of the schools. Mr. MacDonald justly remarks that "while the moral and intellectual sides of education necessarily exist together, yet society is most solicitous about the former; for an individual may be a good citizen with little instruction if he has sound morality, but the reverse is not true." This, however, immediately raises the perplexing question, which is as old as Socrates, and which moralists of all ages have tried to answer, whether virtue can be taught, and, if so, by what means; but though our author realizes the importance of the problem, we cannot see that he contributes anything new to the solution of it.

The relation of education to crime, however, is only one of the topics discussed in this book, which deals with the whole subject of criminology with special attention to the question of preventing crime. In pursuing this theme the author says little directly about remedies, but confines himself mainly to the study of causes, on the ground that "all the conditions, occasions and causes of crime must be investigated first, if the treatment is to be a rational one." After pointing out the special topics for inquiry in criminology, he proceeds to set forth the views that have been advanced by leading writers on the subject in recent years, with special reference to the theories of the Italian school, which inclines to regard crime as a mental